ALD deposited thin films as model electrodes: a case study of the synergistic effect in Fe_2O_3-SnO_2

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TOPIC 4: Devices: integrating ALD processes for oxides, sulfides and nitrides

Abstract: Developing higher capacity electrode materials is a key challenge in battery research [1]. Materials which undergo conversion and/or alloying reactions such as Fe_2O_3 and SnO_2 offer a high theoretical capacity, but suffer from huge volumetric changes and poor conductivities [2], [3]. However, it is shown that combining the SnO_2 and Fe_2O_3 into a single electrode layer can induce a synergistic effect, enhancing electrode characteristics [3]–[6]. Using atomic layer deposition (ALD), we deposited carefully controlled model system thin-film electrodes of both phase-pure Fe_2O_3 and SnO_2, as well as mixtures thereof in the form of either nanolaminates and 'atomically intermixed' films. These were used to investigate the length scale of mixing at which these synergistic effects are maximized. It was found that intermixing at length scales at least lower than 2 nm is required for good cycling performance of intermixed transition metal oxide anodes.

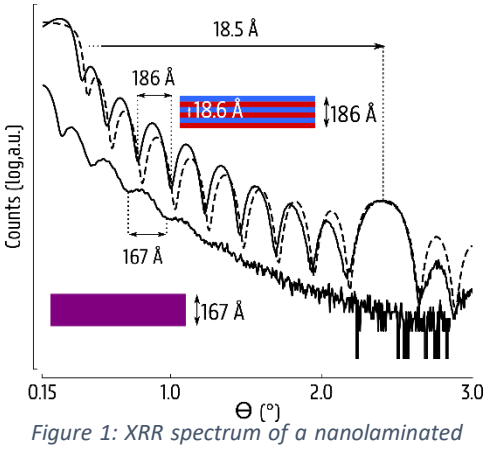

Figure 1: XRR spectrum of a nanolaminated and an intermixed sample, together with a nanolaminate simulation.

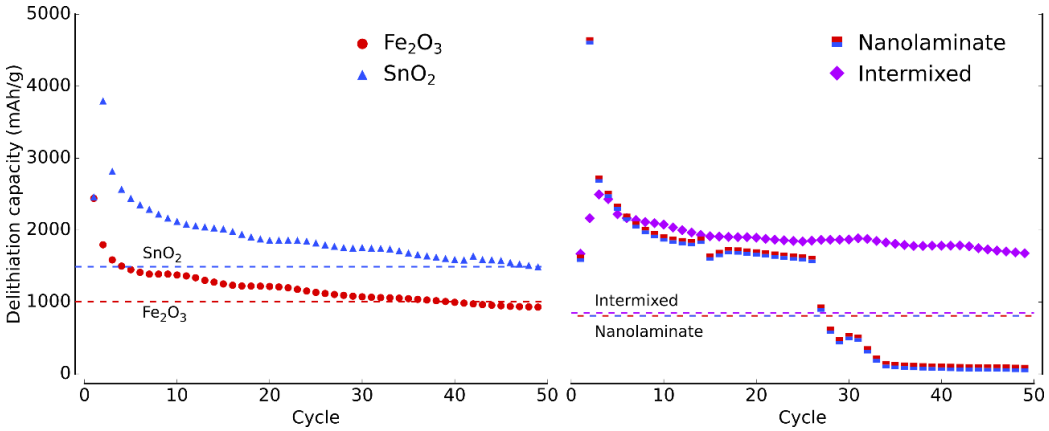

Figure 2: Capacities for 50 cycles for the four samples under investigation.

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